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A NEW EARLY PLEISTOCENE BIRD ASSOCIATION FROM PIETRAFITTA (PERUGIA, CENTRAL ITALY)

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Abstract. We here present the preliminary results of the analysis of the fossil bird assemblages found in the lignite deposits of the Pietrafitta Mine (Perugia, Central Italy).

A rich vertebrate association, mainly mammals, has been retrieved in Pietrafitta, which is the richest local fauna of the Farneta Faunal Unit (late Villafranchian, early Pleistocene).

Avian remains of Podicipedidae, Ardeidae, Phalacrocoracidae, Anatidae, Phasianidae e Rallidae have been identified, for most of which Pietrafitta represents the earliest occurrence in Italy. The Pietrafitta fossil bird association is the first Italian bird assemblage of the early Pleistocene and seems to be one of the most important ones for the early Pleistocene in Europe, especially because it contains mainly aquatic birds, often rare in many other European deposits.

Riassunto. In questo lavoro vengono presentati i risultati preliminari dello studio dei resti fossili di uccelli, recuperati nella miniera di Pietrafitta (Perugia, Italia centrale). Dai depositi organici sfruttati a cielo aperto, proviene una ricca associazione a vertebrati costituita principalmente da mammiferi, che rappresenta la più ricca fauna locale dell'Unità Faunistica di Farneta (Villafranchiano superiore, Pleistocene inferiore).

Lo studio effettuato ha permesso di identificare le seguenti famiglie di uccelli: Podicipedidae, Ardeidae, Phalacrocoracidae, Anatidae, Phasianidae e Rallidae, e per molte di queste Pietrafitta rappresenta la prima segnalazione in Italia.

L'avifauna fossile di Pietrafitta è la prima associazione ornitica del Pleistocene inferiore della penisola italiana e in particolare, per la presenza di uccelli acquatici spesso rari in molti depositi dell'Europa, una delle associazioni più importanti nel panorama delle avifaune europee del Pleistocene inferiore.

Introduction

In the western Palearctic, Early Pleistocene birds are known only from a limited number of localities (Tyrberg 1998) and most of them are characterized by caves and fissure infilling deposits (karstic sites), where terrestrial species and small forms often prevail.

The open-cast mine lignite deposits at Pietrafitta (province of Perugia, Central Italy) yielded a rich collection of fossil bird remains, primarily of aquatic species. This site represents the first avian assemblage of the early Pleistocene in Italy.

The lignites of Pietrafitta, used as fuel for the local Thermoelectric Power Station of the Italian National Electricity Corporation (ENEL S.p.a), have been known in the literature since the second half of the 19th century (Ambrosetti et al. 1992a). Vertebrate finds from the lignite mine have been reported by several authors (Moretti 1949; Ambrosetti et al. 1983; Ambrosetti et al. 1987b), and mammals in particular have been the subject of many studies (see Gentili et al. 1996 with bibliography).

Avian remains from Pietrafitta were originally mentioned by Ambrosetti et al. (1987b) with further comments by Gentili et al. (1996). Here, we provide a first preliminary description of the abundant avian materials retrieved from the lignite deposits during excavations. The material was recovered from three sites of the lignite mine at different times, between about 1960 and 1994.

Geology and paleontology

The lignites of Pietrafitta are part of the lacustrine succession of the Tavernelle basin (Ambrosetti et al. 1977; Conti & Esu 1981; Ambrosetti et al. 1987a; Ambrosetti et al. 1989), which surrounds the high valley of the River Nestore (Fig. 1).

The deposition of the lignites took place during the early Pleistocene, probably as a result of tectonic movements that caused the elevation of the delta of the Paleo-Nestore and the consequent formation of several small basins char-

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Fig. 1 - Location of the study area: a) Miniera vecchia; b) Poderetto; c) Poderone.

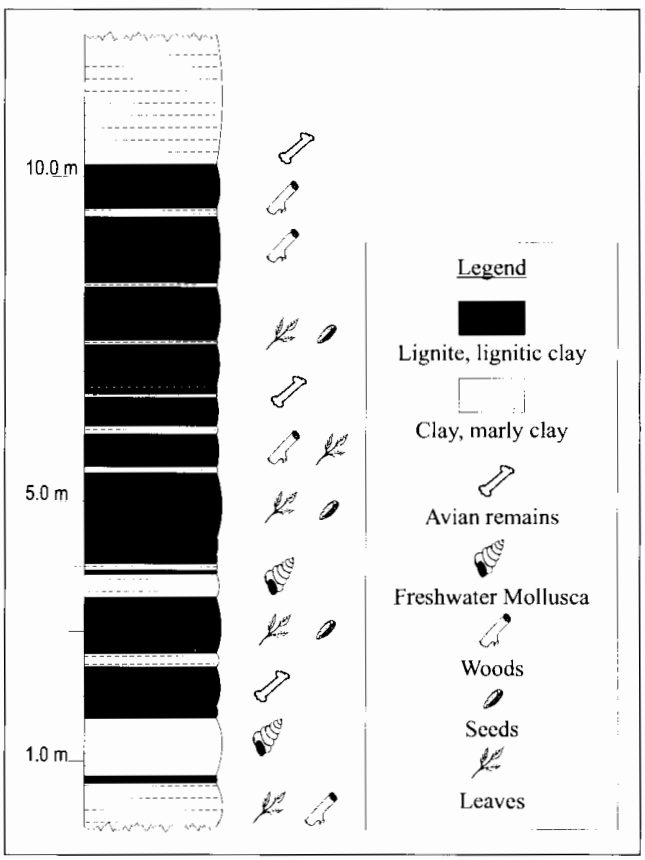

Fig. 2 - Geological log of the Poderone lignite mine stratigraphic section.

acterised by brackish water (Ambrosetti et al. 1989).

The lignite lithosomes are made up predominantly of herbaceous species amongst which specimens of Cyperaceae and Graminaceae have been recognized (Ambrosetti et al. 1992b). The plant remains were deposited in situ and fine strata of organic clays containing interformational clasts, and molluscs locally interrupt the succession. The depositional picture suggests that the lignite was deposited in a swampy area at the border of a lacustrine basin with fine clastic sedimentation, characterized by abundant organic production (marshland) (Ambrosetti et al. 1992b).

The Pietrafitta lignites have yielded many fossil remains of vertebrates, invertebrates, macroflora and pollens (Gentili et al. 1996; 2000). The vertebrates, mainly mammal fauna, have been extensively studied (Kotsakis & Gregori 1985; Masini 1989; Masini & Torre 1990; Masini & Santini 1991; Azzaroli & Mazza 1993; Mazza et al. 1993; Rustioni & Mazza 1993; Abbazzi 1995; Rook 1995; Gentili et al. 1996, 1997; Maul et al. 1998; Ferretti 1999; Reggiani 1999; Gentili & Masini 2000; Azzaroli 2002; Delfino 2002) and the following taxa have been identified: *Latonia* cf. *L. ragei*, *Rana* gr. *R. ridibunda*, Colubrines indet., *Natrix* sp., *Vipera* cf. *V. ammodytes*, *Emys orbicularis*, *Sorex* sp., *Talpa* sp., *Macaca sylvana-florentina, Castor plicidens, Oryctolagus etruscus, Microtus (Allophaiomys)* cf. *ruffoi, Microtus (Allophaiomys) chalinei, Mimomys pusillus*, *Sciurus* sp. (Maul, personal communication), *Ursus etruscus*, *Panthera gombaszoegensis, Pannonictis nestii, Stephanorhinus* cf. *S. hundsheimensis*, *Equus* sp., *Leptobos* aff. *L. vallisarni*, *Megaceroides obscurus*, *Pseudodama farnetensis*, *Mammuthus meridionalis vestinus*.

The mammal fauna allows us to refer the Pietrafitta assemblages to the Farneta Faunal Unit of the late Villafranchian, early Pleistocene, corresponding to the late MN18 of the European Mammal Biochronology (Masini et al. 1990; Torre et al. 1992; Masini et al. 1995; Ficcarelli et al. 1996; Gentili et al. 1996; Gliozzi et al. 1997; Azzaroli 2001; Torre et al. 2001).

The fossil bird remains have been found in three different part of the lignite quarry: Miniera Vecchia, Poderetto and Poderone (Gentili et al. 1996). All the bird remains came from the lignite levels, apart for a partial skeleton of *Somateria* aff. *mollissima* collected in a clay level overlaying the lignite levels (Fig. 2). The bird remains have often been found in anatomical connection and do not show traces due to mechanical transport or biomechanical erosion. The conservation of the bones and the presence of some skeletons, including those of mammals, in anatomical connections, suggest that the vertebrate remains have been deposited in situ (Gentili 1991; Ambrosetti et al. 1992b).

The bird bones are often complete, even if they are generally flattened and fractured, because of recent tectonic movements (Menichetti 1997) and sediment loads. The modifications normally involve the diaphysis of the bones and so it is always possible to use the Pietrafitta remains to give morphological descriptions and make biometrical observations.

Specimen	Taxon	Skeletal element	Measurement						
			a	b	c	d	d*	e	f
AV 1/1299	*Podiceps* sp.	left coracoid	-	-	5.9	-	-		3.5
AV 2/1207	*Podiceps* sp.	right coracoid	-	-	-	-	13.0	-	4.0
AV 3/-	*Phalacrocorax* sp.	right tarsometatarsus	-	-	-	13.0		-	7.6
AV 4/1073	cf. *Ixobrychus*	right coracoid	-	6.7	3.5	-	-	-	2.0
AV 27/1094-1#	*Cygnus* sp.	right coracoid	100.0	21.65	22.0	-	-	11.0	13.5
AV 33/1094-42#	*Cygnus* sp.	right humerus	287.0	54.8	25.25	35.6		22.0	-
AV 35/1162	*Cygnus* sp.	right humerus	-	-	-	(36)		31.3	-
AV 34/1306	*Cygnus* sp.	left humerus	-	50.0	21.8	34.8		19.0	-
AV 39/1094-6#	*Cygnus* sp.	right ulna	-	24.0	-	24.0		18.3	-
AV 38/1094-3	*Cygnus* sp.	left ulna	-	-	-	22.0		17.15	-
AV 44/1237	*Cygnus* sp.	right radius	-	12.0	11.8	-		-	8.0
AV 45/1094-41#	*Cygnus* sp.	right radius	267.0	11.8	12.0	15.7		8.0	8.0
AV 46/1306	*Cygnus* sp.	right radius	-	-	-	15.7		7.3	8.0
AV 47/1172	*Cygnus* sp.	right carpometacarpus	-	-	-	14.5		11.7	8.0
AV 50/1094-12#	*Cygnus* sp.	left carpometacarpus	-	-	-	14.5		11.7	-
AV 66/1094-5#	*Cygnus* sp.	right tibiotarsus	-	-	-	21.5		23.4	11.0
AV 70/1308	*Cygnus* sp.	right tibiotarsus	-	-	-	-		22.7	-
AV 71/1162	*Cygnus* sp.	right tibiotarsus	-	-	-	22.4		23.3	-
AV 65/1277	*Cygnus* sp.	left tibiotarsus	-	-	-	23.0		24.6	(11.5)
AV 69/1094-28#	*Cygnus* sp.	left tibiotarsus	-	-	-	21.0		23.0	-
AV 74/1094-20#	*Cygnus* sp.	right tarsometatarsus	-	23.7	21.3	-		-	-
AV 73/1094-08#	*Cygnus* sp.	left tarsometatarsus	-	24.0	-	23.0		18.7	-
AV 110/1235	*Anas* big-size group	left coracoid	-	9.8	-	-	-	-	-
AV 112/1741	*Anas* big-size group	left coracoid	-	10.0	-	-	-	-	-
AV 113/1307	*Anas* big-size group	left coracoid	49.0	-	-	-	-	(3.5)	5.4
AV 97/1806	*Anas* big-size group	right humerus	-	17.0	9.0	-		-	-
AV 100/1300	*Anas* big-size group	left ulna	-	-	-	7.5		8.3	5.0
AV 101/1300	*Anas* big-size group	left radius	63.0	5.0	4.7	6.0		3.8	3.0
AV 115/1741	*Anas* big-size group	left radius	-	4.0	4.8	-		-	-
AV 102/1236	*Anas* big-size group	right carpometacarpus	48.2	11.4	5.0	6.0		4.2	3.4
AV 109/-	*Anas* big-size group	right carpometacarpus	61.3	14.0	7.0	7.4		5.5	4.4
AV 103/1300	*Anas* big-size group	left carpometacarpus	50.0	11.7	6.0	7.0		4.9	4.4
AV 104/1092	*Anas* big-size group	left carpometacarpus	50.0	7.4	5.5	7.6		5.6	4.7
AV 105/1C	*Anas* big-size group	left carpometacarpus	-	-	-	7.0		4.8	-
AV 116/1741	*Anas* big-size group	left carpometacarpus	-	11.2	4.5	-		-	-
AV 120/ 1247	*Anas crecca/querquedula*	right coracoid	-	8.0	2.5	-	-	-	-
AV 119/-	*Anas crecca/querquedula*	left humerus	-	-	-	10.0		6.0	5.3
AV 134/1156	*Aythya* sp.	left humerus	-	17.7	9.6	-		-	-
AV 141/-	*Somateria* aff. *mollissima*	right coracoid	-	(13.4)	-	-	-	-	7.6
AV 138/5#	*Somateria* aff. *mollissima*	left coracoid	-	15.0	9.2	-	-	-	-
AV 140/1246	*Somateria* aff. *mollissima*	left coracoid	-	(13.6)	-	-	-	-	7.8
AV 142/1146	*Somateria* aff. *mollissima*	left coracoid	-	13.0	-	-	-	-	7.4
AV 143/1201	*Somateria* aff. *mollissima*	left coracoid	-	14.4	-	-	-	-	7.3
AV 146/5#	*Somateria* aff. *mollissima*	left humerus	-	24.2	13.6	16.8		10.0	8.0
AV 148/2#	*Somateria* aff. *mollissima*	left ulna	-	11.85	11.5	10.3		11.2	6.4
AV 149/3#	*Somateria* aff. *mollissima*	left radius	-	5.9	6.5	8.0		4.0	3.5
AV 151/1#	*Somateria* aff. *mollissima*	left carpometacarpus	65.3	15.8	7.3	9.0		6.0	5.0
AV 170/1297	*Somateria* aff. *mollissima*	left tarsometatarsus	-	-	-	-		-	5.4
AV 172/1169	cf. *Gallus*	right humerus	89.0	29.0	3.5	21.8		11.4	9.0
AV 173/1C	cf. *Gallus*	right tarsometatarsus	81.35	14.8	11.6	15.0		12.0	6.3
AV 175/1086	Rallidae gen.et sp. indet.	left coracoid	-	6.0	4.5	-	-	-	3.0

Tab. 1 - Measurements (in mm) of the bird bones from the Pietrafitta lignite mine.
Legend: **a** = greatest length; **b** = depth of the proximal end; **c** = width of the proximal end; d = depth of the distal end; **d*** = width of the facies articularis sternalis (coracoid only); **e** = width of the distal end; f = width of the bone in the middle; "#"= single individual; "( )"= estimated value; "-"= missing value.

Systematic Palaeontology

In the Pietrafitta lignite mine deposits, something more than a hundred avian fossil remains have been found, most of them relatively well preserved. A preliminary morphological analysis of the material has been carried out by one of the authors (Zucchetta 2001) using the modern skeletal collection stored in the Museum of Pordenone (courtesy Prof. B. Sala) and the "Marco Pavia Osteological Collection" stored in the Dipartimento di Scienze della Terra (Earth Sciences Department) of the Torino University. After this analysis it was evident that

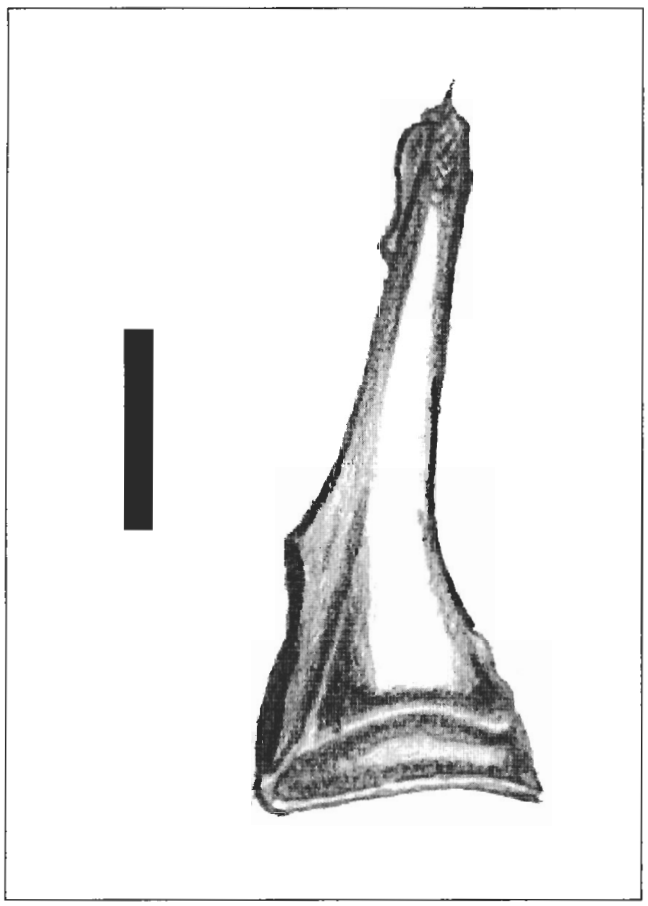

Fig. 3 - *Podiceps* sp., AV 2/1207 right coracoid, ventral view. Scale bar 10 mm.

the fossil bird association of Pietrafitta contains at least nine taxa: *Podiceps* sp., *Phalacrocorax* sp., cf. *Ixobrychus*, *Cygnus* sp., *Anas* big-size group, *Anas crecca/querquedula*, *Aythya* sp., *Somateria* aff. *mollissima*, cf. *Gallus*, Rallidae indet. The anatomical nomenclature used in the text and figures follows that of Baumel & Witmer (1993). The systematics used is that indicated by del Hoyo et al. (1992, 1994, 1996). The measurements taken on the fossil remains (Tab. 1) follow the suggestions of Mourer-Chauviré (1975) and Von den Driesch (1976). The specimens studied here are deposited at the Centro di Ateneo per i Musei Scientifici (University Centre for Scientific Museums or CAMS, Collection AV) of the University of Perugia.

Aves

Podicipediformes

Podicipedidae

Podiceps Latham, 1787

Podiceps sp.

Fig. 3; Tab. 1

Material. AV 2/1207 incomplete right coracoid, AV 1/1299 incomplete left coracoid.

Description. The two coracoids show the typical features of the genus *Podiceps*, with the structure of the coracoid very simplified, which allows no confusions with other bird groups. The measurements (Tab. 1) are similar to those reported by Bochensky (1994) for the extant *Podiceps cristatus* and *Podiceps grisegena*, which are larger than the other European species.

Discussion. The genus *Podiceps* has been known since the Early Miocene by the species *Podiceps oligocaenus* in North America (Olson 1985), while in Europe its earliest remains date to the Late Miocene (Bochensky 1997). The dimensions of the Pietrafitta remains are larger than the extant *Podiceps auritus* and than the extinct *P. pisanus* and *P. howardae*, both recently synonymized with *P. auritus* by Olson & Rasmussen (2001). The measurements also seem to be similar to those of other extinct species described from the Neogene and Pleistocene of North America, such as *Podiceps oligoceanus*, *P. subparvus*, *P. parvus* and *P. dixi* (Brodkorb 1963; Storer 2001), with which the Pietrafitta remains need to be compared.

Pelecaniformes

Phalacrocoracidae

Phalacrocorax Brisson, 1760

Phalacrocorax sp.

Fig. 4; Tab. 1

Material. AV 3/- proximal end of right tarsometatarsus.

Description. The specimen is well preserved and shows the typical features of the genus *Phalacrocorax*. This differs from *Morus* through the more developed crista mediano plantaris, even more developed than in *Phalacrocorax*; the eminentia intercotylaris shows prominent proximal protrusion, while in *Morus* this feature is much less pronounced. The fossil remain seems to be a little shorter and stouter that the extant *Phalacrocorax carbo*, even if it is definitely larger that the extant *Phalacrocorax aristotelis*.

Discussion. The genus *Phalacrocorax* has been known in Europe since the Late Miocene with different extinct species (Bochensky 1997). During the Neogene different extinct form of the this genus were described in Europe, North America and Africa, none of them comparable in size with the Pietrafitta remain (Bochensky 1997; Brodkorb & Mourer-Chauviré 1984; Olson & Rassmussen 2001; Schluter 1991). From the Pliocene of Italy Regalia (1902) described the new species *Phalacrocorax destefani* as a small form of the genus, even smaller of the extant *P. aristotelis*, so definitively smaller than the Pietrafitta remain. The tarsometatarsus found in the Pietrafitta lignite mine shows morphological and morpho-

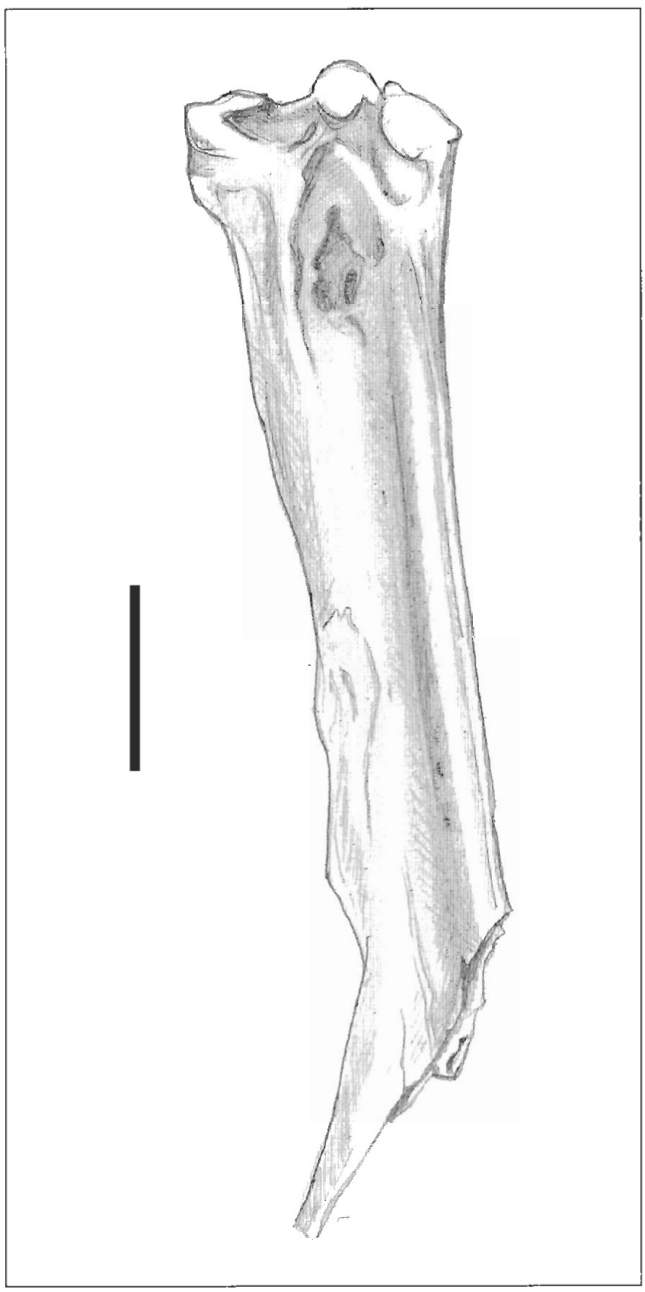

Fig. 4 - *Phalacrocorax* sp., AV 3/- proximal right tarsometatarsus dorsal view. Scale bar 10 mm.

metrical differences with any other *Phalacrocorax* species known so far, even with the more similar in size *P. carbo*. At the moment the material is too scarce to allow the description of a new species of *Phalacrocorax* and so we prefer to leave the determination at the generic level.

Ciconiiformes

Ardeidae

Ixobrychus Billberg, 1828

cf. **Ixobrychus**

Tab. 1

Material. AV 4/1073 proximal part of right coracoid.

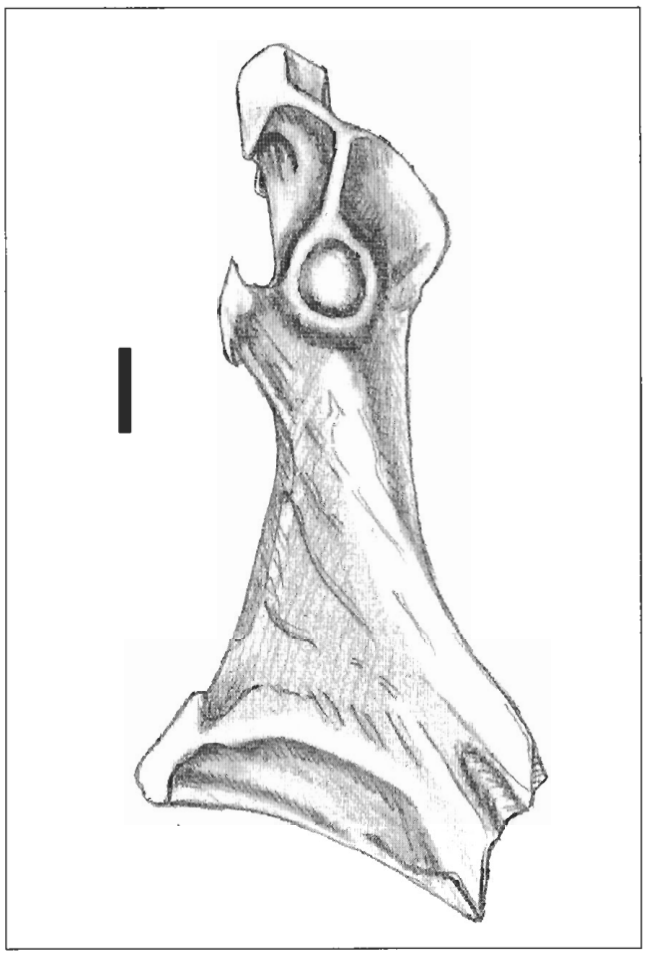

Fig. 5 - *Cygnus* sp., AV 27/1094-1 right coracoid, dorsal view. Scale bar 10 mm.

Description. The specimen shows the typical features of the family Ardeidae; in particular it differs from other Ciconiiformes in having the facies articularis clavicularis in continuity with the shallow sulcus musculi supracoracoidei. The dimensions are a little larger than those of the modern *Ixobrychus minutus*, from which it also differs in some morphological details.

Discussion. *Ixobrychus* is the smallest member of the European heron genus, even if *Ardeola* and *Butorides* are sometimes only slightly larger (Pavia 2000; Tchernov 1980). This genus has been known in the Palearctic since the middle Pleistocene (Tyrberg 1998); in fact the early Pleistocene record of cf. *Ixobrychus* from Ubeidiya (Tchernov 1968) has subsequently been changed to *Butorides* sp. by the same author (Tchernov 1980), so the Pietrafitta record, if confirmed, will represent the earliest occurrence of the genus.

Anseriformes

Anatidae

Cygnus Bechstein, 1803

Cygnus sp.

Figs. 5-6; Tab. 1

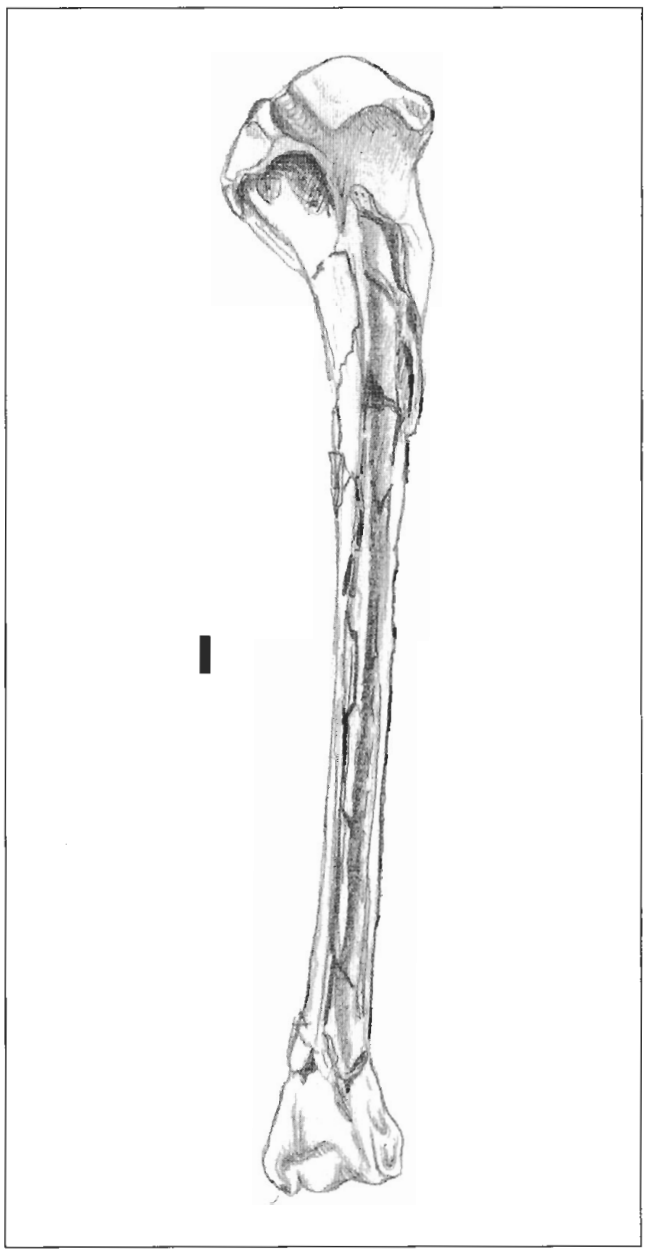

Fig. 6 - *Cygnus* sp., AV 33/1094-42 right humerus, caudal view. Scale bar 10 mm.

Material. AV 27/1094-1 right coracoid, AV 26/1237 left coracoid, AV 28/1306 left coracoid, AV 32/1197 right humerus, AV 33/1094-42 right humerus, AV 35/1162 right humerus, AV 36/1097 right humerus, AV 34/1306 left humerus, AV 37/1097 left humerus, AV 39/1094-6 incomplete right ulna, AV 3/1308 incomplete right ulna, AV 38/1094-3 left ulna, AV 40/1094-29 left ulna, AV 42/1308 left ulna, AV 44/1237 right radius, AV 45/1094-41 right radius, AV 46/1306 right radius, AV 47/1172 incomplete right carpometacarpus, AV 49/1308 incomplete left carpometacarpus, AV 50/1094-12 incomplete left carpometacarpus, AV 66/1094-5 incomplete right tibiotarsus, AV 70/1308 incomplete right tibiotarsus, AV 71/1162 incomplete right tibiotarsus, AV 65/1277 incomplete left tibiotarsus, AV 68/1094-14 incomplete left tibiotarsus, AV 69/1094-28 incomplete left tibiotarsus, AV 74/1094-20 incomplete right tarsometatarsus, AV 76/1094-24 incomplete right tarsometatarsus, AV 77/1162 incomplete right tarsometatarsus, AV 78/1073 incomplete right tarsometatarsus, AV 73/1094-08 incomplete left tarsometatarsus. Some of the bones come from a single individual (see Tab. 1).

Description. The general morphology of the various elements is typical of the Anatidae, particularly of the genus *Cygnus*. Other big Anatidae, like the forms of the genus *Anser*, can be excluded for their smaller dimensions and of some morphological differences in all the long bones, as indicated by Bacher (1967). The Pietrafitta remains were compared with two recent skeletons of *Cygnus olor*, while for *Cygnus cygnus* and *C. columbianus* the osteological characteristics pointed out by Bacher (1967) were taken into consideration. The mean dimensions of the various remains from the Pietrafitta mine are comparable in size with both *Cygnus olor* and *C. cygnus*, even if a few elements are smaller and closer to *C. columbianus*. The morphological characteristics of the long bones are not homogeneous and some bones seem to be more similar to *Cygnus olor* while others appear closer to *C. cygnus*.

Discussion. The genus *Cygnus* has been known in Europe since the middle Miocene (Bochensky 1997), while the modern species have been well established since the middle Pleistocene (Tyrberg 1998). Other evidence also indicates that *Cygnus olor* and *Cygnus columbianus* have been present respectively since the middle Pliocene and early Pleistocene (Mlíkovský 1986; Tyrberg 1998), while *Cygnus* aff. *columbianus* is reported in remains of the early Pliocene of North Carolina (Olson & Rasmussen 2001). Different fossil species have also been described in the European Pleistocene (Bochensky 1997; Tyrberg 1998). The Pietrafitta remains are here determined as *Cygnus* sp. in order to compare them with more skeletal material of the various extant and fossil species and also so as to be able to clarify the relative importance of the different morphological features shown by the Pietrafitta remains themselves.

Genus *Anas* Linnaeus, 1758

The different species of the genus *Anas* have been divided into two size-groups, comprising the various species similar in size. The big-size group comprises the larger forms of this genus currently living in the Western Palaearctic, such as *Anas penelope*, *A. platyrhynchos*, *A. acuta*, *A. strepera* and *A. clypeata*, while the smaller forms, *Anas crecca* and *A. querquedula*, are very similar in size and thus are here treated together.

Anas big-size group

Tab. 1

Material. AV 111/1741 proximal part of right coracoid, AV 110/1235 left coracoid, AV 112/1741 left coracoid, AV 113/1307 left coracoid, AV 97/1806 proximal part of right humerus, AV 100/1300 fragmented left ulna, AV 101/1300 complete left radius, AV 115/1741 proximal part of left radius, AV 102/1236 incomplete right carpometacarpus, AV 109/- incomplete right carpometacarpus, AV 103/1300 incomplete left carpometacarpus, AV 104/1092 incomplete left carpometacarpus, AV 105/1C incomplete left carpometacarpus, AV 116/1741 proximal part of left carpometacarpus.

Description. The material can be referred to the genus *Anas*, clearly separable from other genera of the family Anatidae by reason of a number of morphological characteristics of all the long bones, as has also been pointed out by Woelfle (1967). Morphological and morphometrical differences exist among the Pietrafitta remains; this evidence may suggest the presence of different species in the fossil assemblage.

Discussion. The genus *Anas* includes several extant species, some of them currently found in the Western Palearctic (del Hoyo et al. 1992), and some extinct described in Europe dating to the Middle Miocene (Bochensky 1997; Mlíkovský 2002). Even if Woelfle (1967) identified several morphological characteristics that allow to differentiate the long bones of the genus *Anas* up to the specific level, more recently Olson & Rasmussen (2001) have pointed out the extreme difficulty of distinguishing the postcranial elements of the various species, except as regards their size. For this reason, until the validity of the morphological characteristics of the long bones in the systematic of the genus *Anas* will be testified, we leave the determination as above, to indicate that these remains belong to one or various species of *Anas* of big dimensions.

Anas crecca/querquedula

Tab. 1

Material. AV 120/1247 right coracoid, AV 121/1200 fragmented left coracoid, AV 119/ - incomplete left humerus.

Description. The fossil remains clearly belong to the genus *Anas*, following the morphological characteristics pointed out by Woelfle (1967). We have compared them both with *Anas querquedula* and *A. crecca*, the only two European species comparable in size with the Pietrafitta remains; the fossil remains show little morphological difference.

Discussion. The two species *Anas crecca* and *A. querquedula* are clearly separated in size from all the other Western Palaearctic species. Their mean dimensions largely overlap one to each other, so, also following the opinion of Olson & Rassmussen (2001) about the validity of the morphological characteristics to separate the various *Anas* species, we consider the Pietrafitta remains as belonging to both *Anas crecca* and *A. querquedula*.

Aythya Boie, 1822

Aythya sp.

Tab. 1

Material. AV 134/1156 proximal part of left humerus.

Description. The morphology of this humerus clearly suggests its attribution to the genus *Aythya*; its measurements are a little larger than *Aythya fuligula* and *A. nyroca*, thus more similar to those of *A. ferina* and *A. marila*.

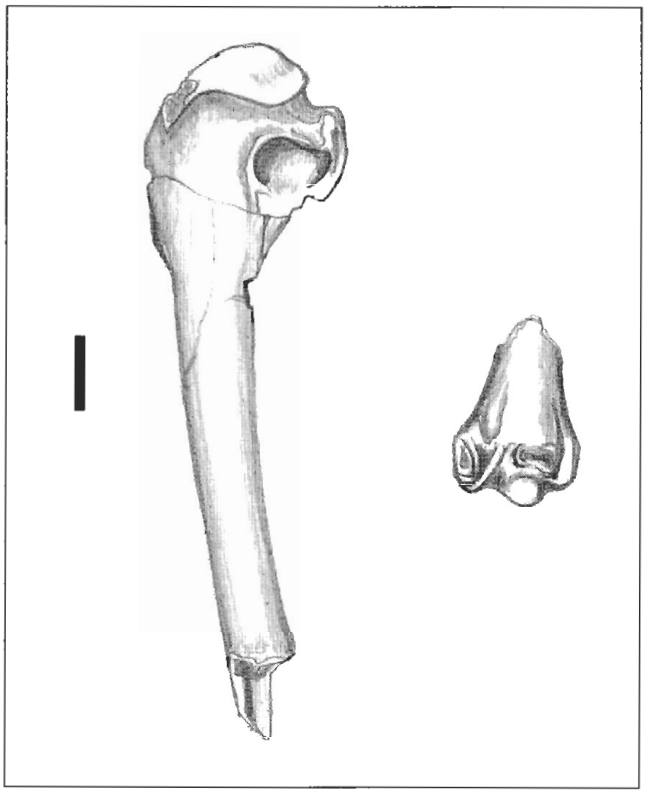

Fig. 7 - *Somateria* aff. *mollissima*, AV 146/5 left humerus, caudal view. Scale bar 10 mm.

Discussion. The genus *Aythya* has been known in Europe with the species *A. arvernensis* described by Lydekker (1891) from the late Oligocene or early Miocene of the Puy-de-Dôme. The validity of this taxon has recently been discussed by Mlíkovský (2002), who considers *A. arvernensis* synonymous with *Mionetta blanchardi*. In the original description of *A. arvernensis* Lydekker (1891) clearly indicated that this species is different from *M. blanchardi*; so *Aythya arvernensis* is still considered here as a valid species and it represents the first occurrence of this genus so far. Outside Europe Olson & Rasmussen (2001) have reported *Aythya* aff. *affinis* from the early Pliocene of North Carolina. In the late Pliocene of Tuscany Portis (1889) described two species *Aythya aretina* and *Aythya sepulta*. These two species have been transferred to the genus *Anas* by Cheneval (1987) under the species *A. aretina* and *A. sepulta*.

Somateria Leach, 1819

Somateria aff. mollissima

Fig. 7; Tab. 1

Material. AV 141/- right coracoid, AV 138/5 left coracoid, AV 140/1246 left coracoid, AV 142/1146 left coracoid, AV 143/1201 left coracoid, AV 146/5 left humerus, AV 148/2 left ulna, AV 149/3 left radius, AV 151/1 left carpometacarpus, AV 164/14 fragmented sternum, AV 165/10 fragmented sternum, AV 166/20 fragmented sternum, AV 170/1297 left tarsometatarsus and several other bone fragments. Some of the bone comes from a single individual (see Tab. 1) in the Poderone area.

Description. The morphological features of several bones from the Pietrafitta Lignite Mine clearly agree with those of the genus *Somateria* (Woefle 1967; Ericson 1987) and differ from *Tadorna*, the only other Anatidae with similar dimensions, by reason of the wider fossa pneumotricipitalis and fossa musculi brachialis and the deeper incisura capitis in the humerus of *Somateria*. The mean dimensions of the Pietrafitta remains are similar to those of the extant *Somateria mollissima*, from which they seem to differ in certain morphological features, like the sulcus musculi supracoracoidei which are deeper in the proximal coracoid, the more pronounced crista ligamenti acrocoracoacromiali in the scapula, the greater dimensions of the crista deltopectoralis and the tuberculum ventrale in the proximal humerus and the smaller dimensions of the condylus ventralis in the distal humerus.

Discussion. The genus *Somateria* has been known in Europe since the early-middle Pleistocene with the extant species *Somateria mollissima* (Mlìkovský 2002; Tyrberg 1998), while in Italy it has been known since the middle Pleistocene (Bedetti 2001). Harrison (1979) described a left tarsometatarsus found in the early Pleistocene of England as the holotype of the new species *Somateria gravipes*. This taxon was later synonymized with *Somateria mollissima* by Mlíkovský (1982), so the English remains represent the first European occurrence of the genus. In the early Pliocene of North Carolina, Olson & Rasmussen (2001) reported the occurrence of the two species *Somateria* aff. *mollissima* and *Somateria* sp., smaller in size than *S. spectabilis* and *S. fischeri*, the two smallest *Somateria* species. The Pietrafitta remains have been determined as *Somateria* aff. *mollissima*, following the criteria applied by Olson & Rasmussen (2001) when the fossil bones are indistinguishable from the recent ones and are apparently ancestral to the modern species, as in the case of the Pietrafitta remains belonging to the genus *Somateria*.

Galliformes

Phasianidae

Gallus Brisson, 1760

cf. Gallus

Fig. 8; Tab. 1

Material. AV 172/1169 right humerus, AV 173/1C right tarsometatarsus, AV 174/1198 pedal phalanx.

Description. The three fossil remains from the Pietrafitta mine are well preserved and can clearly be attributed to the Galliformes because of their general morphology. The dimensions of the bones are comparable with those of the medium-sized Galliformes: *Gallus gallus*, *Phasianus colchicus* and *Tetrao tetrix*. The morphological characteristics are more similar to those of the genus *Gallus* than to the other species, even if the tuberculum ventrale in the proximal humerus of the Pietrafitta remain

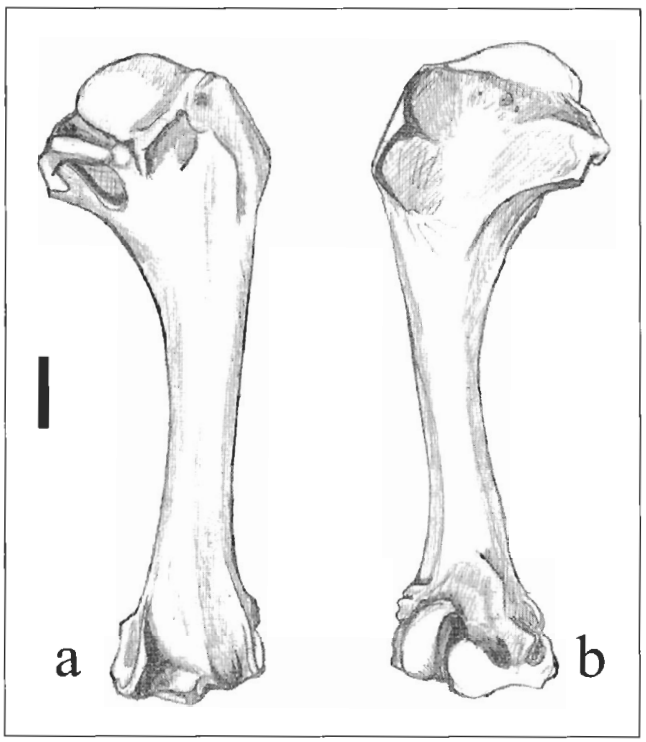

Fig. 8 - cf. *Gallus*, AV 172/1169 right humerus: a) caudal view, b) cranial view. Scale bar 10 mm.

is clearly larger than that of the modern *Gallus gallus*.

Distribution. The European distribution of the genus *Gallus* during the Plio-Pleistocene is uncertain. Some fossil forms have been described from the Miocene to the Pleistocene under the genus *Gallus*, but their systematic position has been changed (Bochensky 1997; Mlíkovský 2002). The modern form *Gallus gallus* seems comparable to those of the late Pleistocene or Holocene in the Middle East (Tyrberg 1998). In the early Pliocene of Perpignan, Depéret (1890) referred a fragmentary coracoid and a complete tarsometatarsus to the early described *Gallus bravardi* (Gervais 1848). More recently Mourer-Chauviré (1989) demonstrated that the fragmentary tarsometatarsus of *Gallus bravardi* used by Gervais (1849) to describe the new species of *Gallus* and the complete tarsometatarsus described by Deperét (1890), actually belonging to an extinct form of the genus *Pavo*, under the name *Pavo bravardi*. In the same paper, Mourer-Chauviré (1989) also demonstrated that the fragmentary coracoid is morphologically similar to the genus *Gallus* and she proposed to determine it as *Gallus* sp. If the attribution of the Pietrafitta remains will be confirmed, these will represent the first occurrence of the genus *Gallus* in Italy and one of the few finds in Europe up to now. To better the determination of the Pietrafitta remains up to the specific level, we need to analyse them together with the *Gallus* sp. described by Deperét (1890) and compare them with some species of Galliformes of similar size both living and fossil, mainly found in the Oriental part of the Palaearctic region (del Hoyo et al. 1994; Tyrberg 1998).

Fig. 9 - Rallidae gen. et sp. indet., AV 175/1086 proximal left coracoid, dorsal view. Scale bar 5 mm.

Gruiformes

Rallidae

Rallidae gen. et sp. indet.

Fig. 9; Tab. 1

Material. AV 175/1086 proximal part of left coracoid.

Description. The morphology of this remain is typical of the Family Rallidae, with the processus acrocoracoideus and the facies articularis clavicularis fused together. The facies articularis humeralis is very well pronounced, as is the cotyla scapularis. The specimen is slightly smaller than the species of the genus *Fulica* and similar in size to those of the genus *Gallinula* and *Crex*, definitely larger than *Rallus* and *Porzana*.

Discussion. The Family Rallidae is well known in the fossil record with several records of both fossil and living species (Bochensky 1997; Mlíkovský 2002; Tyrberg 1998). In the early Pleistocene of Ubeidiya, Tchernov (1968, 1980) described two new species of Rallidae: *Gallinula gigantea* and *Fulica stekelesi*, the first one having dimensions intermediate between the extant species *Fulica atra* and *Gallinula chloropus*, like the Pietrafitta remain, which still remains at the family level, also because of its fragmentary status.

Concluding remarks

The fossil bird association found in the Pietrafitta lignite mine is characterized by big or medium-sized bones while the small forms, particularly the Passeriformes, are completely absent. These are normally less abundant in aquatic environments than in terrestrial ones, but their absence is probably also due to the fact that the Pietrafitta fossil bones have always been collected directly on the outcrops, while the greater part of the small-sized bones are normally found by sieving the sediments (Ericson 1987). Different attempts to sieve the lignite levels have been made both manually and electrically but always unsuccessfully, both due to the physical characteristics of the lignite itself and to the probable low density of the fossil remains of small avian forms.

The fossil bird association found in the Pietrafitta lignite mine comprises at least nine taxa, most of them being true aquatic birds: *Podiceps* sp., *Phalacrocorax* sp., *Cygnus* sp., *Anas* big-size group, *Anas crecca/querquedula*, *Aythya* sp. and *Somateria* aff. *mollissima*.; two other taxa are terrestrial birds closely related to an aquatic environment, particularly to reedbeds: cf. *Ixobrychus* and Rallidae gen. et sp. indet., while the ninth and last one, cf. *Gallus*, represents a true terrestrial form related to thick forests. Following the ecological information obtained by the taxonomical composition of the fossil bird assemblage and according to the sedimentological and other palaeobiological data (Ambrosetti et al. 1992b; Gentili et al. 1996), it is possible to hypothesize the presence in the Pietrafitta area during the early Pleistocene of a lacustrine basin with open water surrounded by wide reedbeds and dense forests, with in addition some glades, as is also suggested by mammal species such as *Equus* sp.

The early Pleistocene fossil bird remains found in the Pietrafitta lignite mine represent one of the few bird associations of this period yet known in Europe (Mourer-Chauviré 1993; Tyrberg 1998), especially one that contains aquatic birds (Louchart et al. 1998; Sanchez 1999b). This is particularly true in Italy, where, apart from a few studies regarding fossil bird remains of Central Italy (Portis 1889; Regalia 1902), the analysis of fossil bird assemblages have mainly involved the late Pleistocene human localities (Pavia 1999; Tyrberg 1998). A comparison of the Pietrafitta assemblage with other localities of the same period in other parts of Europe (Kretzoi 1962; Jánossy 1965, 1974a, 1974b, 1983; Louchart et al. 1998; Sanchez 1999a, b; Tyrberg 1998) is also important to improve our knowledge of the palaeobiogeographical distributions of different bird species during the Plio-Pleistocene, particularly for certain taxa, like *Cygnus*, which are well documented in a number of localities.

The fossil bird association of Pietrafitta is at present one of the richest avian assemblages for which a reliable integrated stratigraphic check is available. Furthermore both taphonomical data and the reduced morphological variability of the large mammals found in the lignite (Gen-

tili & Masini 2000) guarantee that the faunal sample is truly representative of an avian fauna restricted to a very short geological time-interval since lignite deposits are laid down over a chronologically short time span (Martini, personal communication).

The analysis of the fossil bird remains already found in the Pietrafitta lignite mine is still in progress, with comparisons of the fossil bones with more recent fossil material presently being carried out in order to clarify their taxonomical position and, although quarrying activities are now halted, further excavations are being made to find more bird material so as to complete the fossil bird association.

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